CLAIMS:

1. A solid state device comprising a p-n junction containing a p-type group II-VI semiconductor material and an n-type semiconductor material, wherein the p-type group II-VI semiconductor comprises a single crystal thin film of a group II-VI semiconductor comprising atoms of group II elements and atoms of group VI elements, wherein the group II-VI semiconductor is doped with one or more p-type dopants, wherein the p-type dopant concentration in the group II-VI semiconductor is greater than about 10^{16} atoms·cm^{-3}, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about 0.1 cm^2/V·s.

2. A solid state device according to claim 1, wherein the group II elements are selected from zinc, cadmium, alkaline earth metals, and mixtures thereof.

3. A solid state device according to claim 1, wherein the group VI elements are selected from oxygen, sulfur, selenium, tellurium, and mixtures thereof.

4. A solid state device according to claim 1, wherein the p-type dopant is selected from nitrogen, phosphorus, arsenic, antimony, bismuth, copper, and chalcogenides of the foregoing, and mixtures thereof.

5. A solid state device according to claim 1, wherein the p-type dopant is phosphorus.

6. A solid state device according to claim 1, wherein the p-type dopant is arsenic.

7. A solid state device according to claim 1, wherein the p-type dopant is antimony.

8. A solid state device according to claim 1, wherein the p-type dopant is bismuth.

9. A solid state device according to claim 1, wherein the p-type dopant is copper.

10. A solid state device according to claim 1, wherein self supporting substrate surface is amorphous.

11. A solid state device according to claim 1, wherein the thin film of a group II-VI semiconductor is deposited by a chemical deposition process selected from RF sputtering, CVD (chemical vapor deposition), MOCVD (metal organic chemical vapor deposition), spin coating, electrophoresis, and hydrothermal growth processes.

12. A solid state device according to claim 1, wherein the group II-VI semiconductor material is zinc oxide.

13. A solid state device according to claim 1, wherein the group II-VI semiconductor material is zinc sulfide.

14. A solid state device according to claim 1, wherein the device is a light emitting diode.

15. A solid state device according to claim 1, wherein the device is a laser diode.

16. A solid state device according to claim 1, wherein the device is a field effect transistor.

17. A solid state device according to claim 1, wherein the device is a photodetector.

18. A solid state device according to claim 1, wherein the device emits light at a wavelength in the range from about 207 nm to 810 nm.

19. A solid state device according to claim 1, wherein the device emits light at a wavelength of about 441.6 nm.

20. A solid state device according to claim 1, wherein the device emits light at a wavelength of about 325 nm.

21. A solid state device according to claim 1, wherein the group II-VI semiconductor material is disposed on an amorphous self supporting substrate surface.

22. A solid state device according to claim 1, wherein the n-type semiconductor material is an n-type group II-VI semiconductor.

23. A solid state device comprising a p-n junction containing a p-type zinc oxide and an n-type semiconductor material, wherein the p-type zinc oxide comprises single crystal zinc oxide that is doped with one or more p-type dopants, wherein the p-type dopant concentration in the zinc oxide is greater than about 10^{16} atoms·cm^{-3}, wherein semiconductor resistivity is less than about 0.5 ohm·cm, and wherein the carrier mobility is greater than about 0.1 cm^2/V·s.

24. A solid state device according to claim 23, wherein the p-type dopant is phosphorus.

25. A solid state device according to claim 23, wherein the p-type dopant is arsenic.

26. A solid state device according to claim 23, wherein the p-type dopant is antimony.

27. A solid state device according to claim 23, wherein the p-type dopant is bismuth.

28. A solid state device according to claim 23, wherein the p-type dopant is copper.

29. A solid state device according to claim 23, wherein the single crystal zinc oxide further comprises magnesium oxide.

30. A solid state device according to claim 23, wherein the single crystal zinc oxide further comprises cadmium oxide.

31. A solid state device according to claim 23, wherein the n-type semiconductor material is an n-type zinc oxide.

32. A solid state device according to claim 31, wherein the n-type zinc oxide contains an n-type dopant selected from ions of Al, Ga, B, H, Yb and other rare earth elements, Y, Sc, and mixtures thereof.

33. A solid state device according to claim 23, wherein the device is a light emitting diode.

34. A solid state device according to claim 23, wherein the device is a laser diode.

35. A solid state device according to claim 23, wherein the device is a field effect transistor.

36. A solid state device according to claim 23, wherein the device is a photodetector.

37. A solid state device according to claim 23, wherein the device emits light at a wavelength in the range from about 310 nm to 660 nm.

38. A solid state device according to claim 23, wherein the device emits light at a wavelength of about 441.6 nm.

39. A solid state device according to claim 23, wherein the device emits light at a wavelength of about 325 nm.

40. A solid state device according to claim 23, wherein the single crystal zinc oxide is disposed on an amorphous self supporting substrate surface.

41. A solid state device according to claim 23, further comprising a barrier layer disposed between the single crystal zinc oxide and the amorphous self supporting substrate surface.